

Claims

[c1] 1. A method for controlling a process acting on a moving object, the method comprising:

providing a plurality of reference images of a feature of a reference object, the plurality of reference images representing a range of process results corresponding to a first sample time;

obtaining, while the process is acting on the moving object, a first image of a feature of the moving object at a time corresponding to the first sample time; and

comparing the first image to one or more of the plurality of reference images and determining, based upon the comparison result, a necessary process adjustment of one or more process parameters of the process acting on the moving object.

[c2] 2. The method of claim 1, wherein said obtaining the first image includes using a photo-stroboscopic technique.

[c3] 3. The method of claim 1, wherein said plurality of reference images includes images representing each of a below nominal and an above nominal process result pertaining to the feature.

- [c4] 4. The method of claim 1, further comprising, after said comparing and determining, providing an essentially real-time adjustment of said one or more process parameters of the process acting on the moving object.
- [c5] 5. The method of claim 1, further comprising, after said comparing and determining, stopping the process acting on the moving object.
- [c6] 6. The method of claim 1, wherein said comparing includes determining periodic changes to the feature while the process is acting on the moving object.
- [c7] 7. The method of claim 1, wherein said process acting on the moving object includes a CMP process operating on a substrate.
- [c8] 8. The method of claim 1, wherein said process acting on the moving object includes coating a semiconductor wafer with a resist.
- [c9] 9. A system for real-time process control of a manufacturing process operating on a moving object, the system comprising:
 - an image capturing device;
 - a light source;
 - a memory device storing a plurality of reference im-

ages corresponding to at least two process conditions at associated sample times; and a processor operatively connected to the image capturing device, the light source, and the memory device,

wherein the processor strobos the light source and actuates the image capturing device to capture an image of a feature of the moving object at a periodicity corresponding to a movement of the moving object,

wherein the processor compares the captured image to one or more of the stored plurality of reference images in the memory device, and

wherein the processor controls the manufacturing process operating on the moving object based upon changes to the feature during the manufacturing process.

[c10] 10. The system of claim 9, further comprising a video display device controlled by the processor and configured to receive an image from either the image capturing device or the memory device, or both, wherein the video display device receives the image at a refresh rate equal to the periodicity corresponding to the movement of the moving object.

- [c11] 11. The system of claim 9, wherein the processor stops the manufacturing process operating on the moving object based upon the comparison of the captured image to the one or more of the stored plurality of images in the memory device.
- [c12] 12. The system of claim 9, wherein the manufacturing process controlled by the processor is a CMP process operating on a substrate.
- [c13] 13. The system of claim 9, wherein the manufacturing process controlled by the processor comprises coating a wafer with a resist.
- [c14] 14. A manufacturing tool, comprising:
 - a device which performs a process on an object of manufacture so as to cause a periodic movement of the object during the process;
 - a controller operatively coupled to the device;
 - a photo-stroboscopic camera which captures an image of a feature of the object during the process;
 - a memory device storing a plurality of reference images corresponding to two or more process conditions at associated sample times; and
 - a processor coupled to the photo-stroboscopic camera and the memory device,
 - wherein the processor actuates the photo-

stroboscopic camera at intervals corresponding to a period of the periodic movement of the object so as to provide a series of constant orientation images of the feature,

wherein the processor determines changes to the feature during the process based upon a comparison between one or more of the series of constant orientation images and at least one of the stored plurality of reference images, and

wherein the processor communicates with the controller based upon the comparison and commands an adjustment of the process performed by the device on the object of manufacture.

- [c15] 15. The manufacturing tool of claim 14, wherein the device is a polishing tool and the process is a CMP process.
- [c16] 16. The manufacturing tool of claim 15, wherein the processor commands an adjustment of a CMP process.
- [c17] 17. The manufacturing tool of claim 14, wherein the plurality of reference images are stored in the memory device in a database structure.